International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 6, Issue 6, Dec 2016, 145-150

CHARACTER ASSOCIATION AND PATH ANALYSIS FOR GRAIN AND YIELD COMPONENT TRAITS IN POPCORN (*Zea mays* var. *everta* Sturt.)

M. SRIDHAR[1], K. MURALI KRISHNA[2], RAZIA SULTANA[3] & M.H.V. BHAVE[4]

[1,2] *Department of Genetics and Plant Breeding, College of Agriculture, PJTSAU, Rajendranagar, Telangana, India*

[3] *Department of Seed Science and Technology College of Agriculture, PJTSAU, Rajendranagar, Telangana, India*

[4] *Department of Statistics & Mathematics, College of Agriculture, PJTSAU, Rajendranagar, Telangana, India*

ABSTRACT

The present investigation had been undertaken to the estimation of correlation and path analysis of yield and yield contributing characters. Seven inbred lines were crossed in half diallel fashion to obtain 21 crosses. The data was collected on twelve characters including popping expansion ratio. The study of association of yield components with popping ability and path analysis of these characters on yield and popping quality is imperative to enable the selection of inbred lines for the ultimate usage in popcorn hybrid seed production. Correlation studies indicated that grain yield plant^{-1} was positively associated with ear height, ear girth, ear length, number of kernels row^{-1}, number of kernel rows ear^{-1}, plant height, 100-kernel weight and popping expansion ratio. The path coefficient analysis at genotypic level revealed that the character, ear height had exhibited the largest direct effect on grain yield plant^{-1} followed by days to 50 *per cent* ***silking, number of kernels row^{-1}, number of kernel rows ear^{-1} and ear length.***

KEYWORDS: Correlation, Path Analysis, Popcorn, Popping Expansion Ratio

Received: Sep 30, 2016; **Accepted:** Oct 20, 2016; **Published:** Oct 24, 2016; **Paper Id.:** IJASRDEC201621

Original Article

INTRODUCTION

Popcorn, a speciality type of corn is believed to be one of the oldest types of the corn and has been referred to as the original cereal snack food as it is the finest form of flint type available. The kernels of popcorn consist of hard starch grain embedded in colloidal material, which pops on heating and produce large puffed flakes. This character separates popcorn from all other types of corn. Yield in popcorn, as in other crops, is a very complex character and depends upon several component characters. Popcorn quality is measured primarily by the expansion volume and number of unpopped kernels (Song *et al.,* 1991). The study of association of yield components and direct and indirect effects of these characters on yield is imperative to enable the selection of inbred lines for the ultimate use in popcorn hybrid seed production. Keeping in view the aforesaid objective, the present investigation was taken up.

MATERIALS AND METHODS

Seven inbred lines crossed in diallel mating design (method-II, model-I) during *rabi*, 2012-13 at Maize Research Centre, Agriculture Research Institute, Rajendranagar, Hyderabad. The resulting 21 crosses along with parents and standard checks (Amber popcorn and BPCH-6) were evaluated in a Randomized Block Design replicated thrice, during *Kharif*, 2013 at Agricultural Research Station, Karimnagar, Telangana. Each entry was sown in two rows of four meters length with a spacing of 75 cm between rows and 20 cm between the plantshttp://www.ijpaes.com/admin/php/uploads/730_pdf.pdf in a Randomized Block Design, replicated thrice at

Agriculture Research Station, Karimnagar, Telangana. Observations were recorded on five randomly tagged plants for plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-kernel weight and grain yield per plant. Whereas, observations for the characters namely days to 50 per cent tasseling, days to 50 per cent silking and days to maturity were recorded on plot basis. The mean values were used for statistical analysis. Phenotypic and genotypic correlation coefficients were calculated for the characters by working out the variance components of each character and the covariance components for each pair of characters using the formulae suggested by Al-Jibouari *et al.* (1958). The direct and indirect effects for genotypes were estimated by taking seed yield as dependent variable, using path coefficient analysis suggested by Wright (1921) and Dewey and Lu (1959).

The method of popping was done by taking corn grain 100 cc in 100ml cylinder and its weight was measured. Weighed corn was poured into a domestic hot air corn popper which was allowed to run for 2 minutes, until the popcorn completed popping. The expansion volume of corn was measured using a measuring cylinder upto approximately 1000ml. The popping expansion ratio calculated as the ratio of pop volume weight^{1} of popped kernels as reported by Pordesimo *et al*. (1990).

RESULTS AND DISCUSSIONS

Analysis of variance revealed significant differences for all the 11 quantitative traits studied which was presented in Table 1. This indicated the existence of sufficient variability among genotypes for all the characters studied and the parents chosen were diverse with a different genetic background.

Correlation among the traits may be the consequence of the genetic association among the characters. From the breeder's view point, the type of association of grain yield and its component traits is of supreme importance. Phenotypic and genotypic correlations were worked out on yield and yield contributing characters and are presented in Table 2. Genotypic correlations were of higher magnitude than the corresponding phenotypic values which indicate that though there was strong inherent association between characters studied, its expression was reduced due to the influence of environment. Grain yield plant^{-1} was found to be positively associated with ear height, ear girth, ear length, number of kernels row^{-1}, number of kernel rows ear^{-1}, plant height, 100-kernel weight and popping expansion ratio. Hence selection for these characters would improve the yield. Similar results were reported by Vijayabharathi et al. (2009) and Sharma and Kumar (1987).

Ear height exhibited higher genotypic correlations than phenotypic values. It exhibited significant positive genotypic associations with ear length, ear girth, number of Kernel rows per ear, number of kernels per row, 100-kernel weight, popping expansion ratio and grain yield per plant. Similar results were reported earlier in corn for association of grain yield with ear height by Patil *et al*. (1969), Farhatullah (1990), Kumar and Sathyanarayana (2001) and Nataraj *et al*. (2014).

Ear length and ear girth are important traits which affects grain yield. The cobs with higher magnitudes of these characters will accommodate more number of grains and grain rows thus improves grain yield. This is also became evident with the significant positive association of these characters with number of kernels row^{-1} and number of kernel rows ear^{-1} along with other characters such as ear height, popping expansion ratio, plant height and 100-kernel weight. The results were in accordance with the findings of Hua *et al*. (2004) and kumar *et al.* (2007).

The popping expansion was negatively and non-significantly correlated with days to 50 per cent tasseling and days to 50 per cent silking at both phenotypic and genotypic level indicating that it was possible to bred early as well as late popcorn hybrids without affecting the popping quality. Similar results of non-significant associations of popping expansion were reported by Reddy *et al.* (2003).

However popping expansion recorded negative significance with days to maturity at genotypic level. Its phenotypic negative association was not significant indicating the predominance of the environmental influence.

Path analysis depicted the strength of association of all independent variables under study on the grain yield. This analysis also allows separating direct effect and their indirect effects through other attributes by partitioning correlation which helps breeders to find out the characters that could be used as selection criteria in popcorn breeding programme. The Path analysis at genotypic level (Table 3) revealed that ear height exhibited the largest direct effect on grain yield plant^{-1} followed by days to 50 per cent silking, number of kernels row^{-1}, number of kernel rows ear^{-1} and ear length. The present results were commensurate with the findings of Selvaraj and Nagarajan (2011) who reported high direct positive effects for the same characters.

The direct effect of ear height was positive due to the magnitude of positive indirect effects through number of kernels row^{-1}, number of kernel rows ear^{-1}, days to 50 per cent silking and ear length computed its positive association with grain yield. However, the overall effect of days to 50 per cent silking on yield was diluted due to its negative indirect effects via days to 50 per cent tasseling, days to maturity, plant height, ear girth, number of kernel rows ear^{-1} and number of kernels row^{-1} indicating that the selection of this character would be ineffective for improving grain yield plant^{-1}. number of kernels row^{-1} and number of kernel rows ear^{-1} exhibited direct positive effect on grain yield via ear height, days to maturity, ear length, days to 50 per cent tasseling and also along with each other. Ear girth had negative direct effect on grain yield but high positive magnitude of indirect effects via ear height, number of kernels row^{-1} and number of kernel rows ear^{-1}. Cob having more girth accommodates more grain rows results in more grain yield. Significant positive correlation coefficients at genotypic and phenotypic level also confined it most effective trait for using in popcorn breeding.

The negative direct influence of popping expansion on grain yield was nullified by the higher magnitude of its positive indirect effects via days to maturity, ear height, number of kernel rows ear^{-1} and number of kernels row^{-1}. However, it has negative direct effect on grain yield plant^{-1} at genotypic level; hence it could not be a selection criterion for improving the yield in popcorn. The present results can be comparable with the findings of Dofing *et al.* (1991). In contrary direct positive effect of popping expansion ratio on grain yield was reported by Sharma and Kumar (1987) and Vijayabharathi *et al.* (2009)

CONCLUSIONS

Study of correlations revealed that grain yield per plant was positively correlated with ear height, ear girth, ear length, number of kernels row^{-1}, number of kernel rows ear^{-1}, plant height, 100-kernel weight and popping expansion ratio and negatively associated with days to 50 per cent tasseling and days to 50 per cent silking. Path coefficient analysis revealed that ear height exhibited the largest positive direct effect on grain yield per plant followed by days to 50 per cent silking, number of kernels per row, number of kernel rows per ear and ear length appeared to be main factor for their strong association with grain yield per plant. Popping expansion ratio exhibited direct negative relationship with grain yield per plant. Hence direct selection for these traits would be effective.

REFERENCES

1. *Al-Jibouri, H.A., Miller, P.A. & Robinson, H.F. (1958). Genotypic and environment variances in an upland cotton crops of interspecific origin. Agronomy Journal. 50,633-634.*
2. *Dewey, D R . & Lu, K.H.(1959). A correlation and path co-efficient analysis of components of crested wheat grass production. Agronomy journal. 51 (9), 515-518.*

3. *Dofing, S.M., Croz-Mason, N.D. and Compton, M. A. T. (1991). Inheritance of expansion volume and yield in two popcorn x dent corn crosses. Crop Science. 31, 715-718.*

4. *Farhatullah. (1990). Correlated response of maize grain yield with yield contributing traits. Sarhad Journal of Agriculture, Pakistan. 6, 445-457.*

5. *Hua, T., Yiqin, H., Yas-ajianbing and Yonglian, Z. (2004). Genetic analysis of yield traits with elite maize hybrid - Yuyu 22. Acta Agronomica-Sinica. 30, 922-926.*

6. *Kumar, J., Sundaram, T., Prabu, D.A and Rajan, A.R.R. (2007). Correlation studies in maize evaluated for grain yield and other yield attributes. International Journal of Agricultural Sciences. 3, 57-60.*

7. *Patil, S.J., Hayavadan, P.V., Mahadevappa, M.(1969). Interrelationship between grain yield, ear height and internode characters in Zea mays (L.). The Mysore Journal of Agricultural Sciences. 3, 272-276.*

8. *Pordesimo, L. O., Anantheswaran, R. C., Fleishmann, A. M., Lin, Y. E,Hanna,* M. *A. (1990). Physical properties as indicators of popping characteristics of microwave popcorn. Journal of Food Science. 55, 1352-1355.*

9. *Reddy, V. S., Chandra Mohan, Y., Rao, N.V., Krishna, L., (2003). Character association and path analysis in popcorn. (Zea mays var. everta). Crop Research. 25(2), 297-300.*

10. *Selvaraj, C.I., Nagarajan, P. (2011). Interrelationship and path-coefficient studies for qualitative traits, grain yield and other yield attributes among maize (Zea mays L.). International Journal of Plant Breeding and Genetics. 5(3), 209-223.*

11. *Sharma, R.K., Kumar, S. (1987). Association analysis for grain yield and some quantitative traits in popcorn. Crop improvement. 14(2), 201-204.*

12. *Song, A., Eckhoff, S.R., Paulsen, M., Litchfield, J*.B., *1991. Effects of kernel size and genotype on popcorn popping volume and number of unpoped kernels. Cereal Chemistry. 68(5), 464-467.*

13. *Vijayabharathi, A., Anandakumar, C.R., Gnanamalar, R.P., 2009. Analysis of correlations and path effects for popping expansion in popcorn. (Zea mays var. everta Sturt.). Electronic journal of plant breeding. 1, 60-64.*

14. *Wright, S., 1921. Correlation and Causation. Journal of Agricultural Research. 20, 557-585.*

APPENDICES

Table 1: Analysis of variance for Yield and yield Component Characters in Popcorn

Source of variation	d.f	DT	DS	DM	PH	EH	EL	EG	KR/E	K/R	KW	GY/P	PER
Replications	**2**	1.033	0.311	2.533	8.345	77.004	6.832	2.293	0.988	5.984	2.194	13.878	6.395
Genotypes	**29**	2.615*	3.764**	5.297**	289.94**	278.15**	12.87**	5.165**	10.134**	100.97**	24.606**	454.67**	68.49**
Error	**58**	1.321	1.633	2.568	74.503	38.948	2.438	0.827	0.884	6.531	2.727	15.546	3.745

DT: days to 50 per cent tasseling, DS: days to 50 per cent silking, DM: days to maturity, PH: plant height, EH: ear height, EL: ear length, EG:ear girth, KR/E: number of kernel rows per ear, K/R: number of kernels per row, KW: 100-kernel weight, GY/P: grain yield per plant and PER: popping expansion ratio;

*Significant at 5 per cent level; ** Significant at 1 per cent level;

Table 2: Phenotypic (P) and Genotypic (G) Correlation Coefficient Analysis of yield and yield Component Characters in Popcorn

Character		DS	DM	PH (cm)	EH (cm)	EL (cm)	EG (cm)	KRE^{-1}	KR^{-1}	KW (g)	PER	GYP^{-1} (g)
DT	**P**	0.893**	0.805**	-0.007	0.047	-0.052	-0.082	-0.143	-0.106	-0.025	-0.102	-0.004
	G	0.918**	0.982**	-0.162	0.062	0.106	-0.107	-0.155	-0.156	-0.056	-0.170	-0.044
DS	**P**		0.885**	0.0180	0.026	-0.006	-0.034	-0.190	-0.119	-0.059	-0.082	-0.018
	G		1.007**	0.044	0.058	0.127	0.012	-0.189	-0.219*	-0.047	-0.125	-0.068
DM	**P**			-0.024	0.073	0.052	-0.023	-0.249*	-0.113	0.034	-0.107	-0.000
	G			0.127	0.103	0.116	-0.028	-0.267*	-0.223*	-0.019	-0.300**	-0.016
PH (cm)	**P**				0.574**	0.471**	0.430**	0.338**	0.307**	0.421**	0.428**	0.520**
	G				0.898**	0.872**	0.748**	0.637**	0.472**	0.724**	0.714**	0.767**
EH (cm)	**P**					0.641**	0.547**	0.528**	0.605**	0.550**	0.421**	0.737**
	G					0.952**	0.855**	0.752**	0.769**	0.733**	0.582**	0.913**
EL (cm)	**P**						0.551**	0.514**	0.660**	0.502**	0.218*	0.687**
	G						0.857**	0.618**	0.740**	0.795**	0.308**	0.895**
EG (cm)	**P**							0.651**	0.620**	0.426**	0.348**	0.677**
	G							0.841**	0.875**	0.476**	0.460**	0.899**
KRE^{-1}	**P**								0.758**	0.384**	0.429**	0.738**
	G								0.881**	0.500**	0.529**	0.858**
KR^{-1}	**P**									0.400**	0.268*	0.769**
	G									0.553**	0.315**	0.876**
KW (g)	**P**										0.277**	0.617**
	G										0.349**	0.732**
PER (ml g^{-1})	**P**											0.399**
	G											0.500**

P: Phenotypic correlation coefficient; **G:** Genotypic correlation coefficient; *Significant at 5% level; ** Significant at 1% level.

Table 3: Phenotypic (P) and Genotypic (G) path Coefficient Analysis of Yield and Yield Component Characters in Popcorn

Character		DT	DS	DM	PH (cm)	EH (cm)	EL (cm)	EG (cm)	KRE^{-1}	KR^{-1}	KW (g)	PER	GYP^{-1} (g)
DT	P	**0.0260**	0.003	0.041	-0.000	0.008	-0.003	-0.006	-0.036	-0.028	-0.005	-0.001	-0.004
	G	**-0.534**	0.854	-0.424	0.004	0.065	0.004	0.066	-0.046	-0.072	0.004	0.033	-0.044
DS	P	0.023	**0.004**	0.045	0.001	0.004	-0.004	-0.002	-0.048	-0.031	-0.011	-0.001	-0.018
	G	-0.491	**0.929**	-0.435	-0.001	0.060	0.005	-0.007	-0.056	-0.101	0.004	0.024	-0.068
DM	P	0.020	0.003	**0.051**	-0.002	0.012	0.003	-0.001	-0.063	-0.030	0.006	-0.001	-0.000
	G	-0.525	0.936	**-0.431**	-0.003	0.108	0.005	0.017	-0.080	-0.103	0.001	0.058	-0.016
PH (cm)	P	-0.000	0.001	-0.001	**0.093**	0.099	0.034	0.036	0.086	0.082	0.084	0.005	0.520**
	G	0.086	0.041	-0.055	**-0.029**	0.939	0.039	-0.462	0.191	0.218	-0.061	-0.139	0.767**
EH (cm)	P	0.001	0.001	0.003	0.053	**0.173**	0.046	0.046	0.134	0.162	0.110	0.005	0.737**
	G	-0.033	0.053	-0.044	-0.026	**1.045**	0.042	-0.529	0.225	0.356	-0.062	-0.113	0.913**
EL (cm)	P	-0.001	0.000	0.002	0.044	0.111	**0.072**	0.046	0.130	0.176	0.100	0.002	0.687**
	G	-0.056	0.118	-0.050	-0.026	0.995	**0.044**	-0.530	0.185	0.342	-0.067	-0.060	0.895**
EG (cm)	P	-0.002	-0.001	-0.001	0.040	0.095	0.040	**0.084**	0.165	0.165	0.085	0.004	0.677**
	G	0.057	0.011	0.012	-0.022	0.894	0.038	**-0.618**	0.252	0.405	-0.040	-0.090	0.899**
KRE^{-1}	P	-0.003	-0.001	-0.012	0.031	0.091	0.037	0.054	**0.254**	0.202	0.077	0.005	0.738**
	G	0.083	-0.176	0.115	-0.019	0.786	0.027	-0.520	**0.300**	0.407	-0.042	-0.103	0.858**
KR^{-1}	P	-0.002	-0.001	-0.005	0.028	0.105	0.048	0.052	0.193	**0.267**	0.080	0.003	0.769**
	G	0.083	-0.204	0.096	-0.014	0.804	0.033	-0.541	0.264	**0.462**	-0.047	-0.061	0.876**
KW (g)	P	-0.000	-0.000	0.001	0.039	0.095	0.036	0.035	0.097	0.107	**0.200**	0.003	0.617**
	G	0.030	-0.044	0.008	-0.021	0.766	0.035	-0.294	0.150	0.256	**-0.085**	-0.068	0.732**
PER (ml g^{-1})	P	-0.002	-0.000	-0.005	0.040	0.073	0.015	0.029	0.109	0.071	0.055	**0.012**	0.399**
	G	0.091	-0.116	0.129	-0.021	0.608	0.013	-0.284	0.158	0.146	-0.029	**-0.195**	0.500**

Phenotypic residual effect = 0.4405; Genotypic residual effect = 0.3379